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The Soviet Computer Literacy Program: Problems and Prospects

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An Intelligence Assessment

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An Intelligence Assessment

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This paper was prepared by [redacted] Office
of Soviet Analysis, with a contribution from [redacted]
[redacted] SOVA. Comments and queries are
welcome and may be directed to the Chief, Defense
Industries Division, SOVA, [redacted]

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**The Soviet Computer
Literacy Program:
Problems and Prospects** [redacted]

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Key Judgments

*Information available
as of 30 September 1985
was used in this report.*

As part of an overall plan to speed up the rate of scientific-technical progress, the Politburo has endorsed a program to introduce as many as 10 million personal computers (PCs) into secondary and vocational-technical schools over the next decade, both to enhance basic understanding of computer technology and its applications and to aid in the teaching of other subjects. Technical and political problems promise to frustrate the program's implementation during the first several years, but, if these road-blocks can be overcome, the program will provide some significant long-term benefits in industrial development and modernization. [redacted]

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On the political side, the increased use of PCs is a potentially serious threat to party control. Equipped with word-processing software and a printer, a PC could revolutionize the *samizdat* (Soviet underground publication) process. Moreover, PCs provide plant managers with a sophisticated tool that could be used to challenge production quotas and supply figures set by the State Planning Committee and the ministries. Implementation of the literacy program also is being slowed by opposition from officials who view the widespread use of PCs as a threat to the traditional state monopoly of information in the USSR. There is still a significant pocket of resistance that favors the collective departmental method of computing, which relies on large mainframe machines and allows computer use to be more easily controlled. [redacted]

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The most serious obstacles facing the schools are the lack of trained teachers and shortages of equipment. The Soviets' own PC will be manufactured in small quantities for at least the next few years and probably will continue to have reliability problems. A deal for a Western-built turnkey computer plant is the favored option under consideration by the Soviets. COCOM restrictions pose a major obstacle, however. The sale of such a plant would involve the transfer of restricted microelectronics production equipment to make high-speed microprocessors, which have weapons applications. Importing large numbers of PCs may be the best short-term option, but shortages of hard currency and the fear that relying on imports might stifle development of domestic computer production will limit Soviet purchases of Western equipment. [redacted]

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The long leadtimes that have been factored into the computer literacy program are indicative of the difficulties facing the USSR in its campaign. The first—or “preparatory”—stage is to take place during the upcoming 12th Five-Year Plan (1986-90), but the main part of the program is not scheduled to be implemented until the 13th and 14th Five-Year Plans (1991-2000). This extremely slow developing program reflects the current state of affairs in Soviet computing:

- Computer hardware developments lag those in the West by anywhere from four to 10 years according to Intelligence Community estimates.
- The software industry has virtually no experience in developing software for PC applications.
- The computer industry has not been able to produce reliable equipment in significant numbers.
- Computer users are consistently frustrated by poor-to-nonexistent technical service and the lack of spare parts for their computers.
- There is a lack of demand for personal computers at the plant level because industrial managers have few incentives to take the risks associated with incorporating such new technologies.

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Despite these obstacles, which will certainly postpone the payoffs of using computers in the classroom, the literacy program should benefit Soviet automation efforts in the 1990s by:

- Providing the computer industry with a large domestic market for PCs and supporting equipment. This should stimulate technical and industrial development as the industry reaps the benefits of large-scale production and increased funding for R&D.
- Helping to alleviate the critical shortage of computer programmers both by beefing up training programs in technical schools and by creating more interest in computers among students.
- Breaking down some of the resistance to computer use caused by “computer phobia” and ignorance of the potential of PCs in industry.

The Soviets are aware that these benefits will not be realized for some time and that the literacy program will not, by itself, make enterprises run more efficiently. Despite the expected delays, the leadership sees the program as an important component of Moscow's overall effort to foster intensive economic growth through the increased use of computers and automated systems.

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The Soviet Computer Literacy Program: Problems and Prospects

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Soviet Objectives

In January 1985, the Politburo approved a statewide program for the development, production, and effective use of computer technology and automated systems up to the year 2000. The goal of this program is to reequip the national economy of the USSR on the basis of computer technology and microelectronics, thereby increasing labor productivity, raising product quality, and improving management and decision-making. The first area to be targeted is the machine-building sector, where Gorbachev has given a high priority to further automating the manufacture of such complex goods as automobiles, tanks, aircraft, and electronic systems.

The CPSU Central Committee and the USSR Council of Ministers also passed a resolution¹ in early 1985 to foster widespread applications of computers in Soviet education. While envisioning improvements in the teaching process for many subjects, the resolution is targeted mainly at familiarizing students with computer technology, programming, and applications—thereby supporting the modernization program. The approach calls for “teaching students practical computer skills and equipping them with knowledge about the broad use of computers in the national economy.” According to a variety of Soviet statements, the program’s objectives are to: (1) provide the domestic computer industry with a large, steady market for PCs and related equipment, (2) help ease the critical shortage of skilled programmers, and (3) break down some of the resistance to computer use on the part of industrial workers and managers.

This literacy program is to be implemented on two levels, according to a recent Soviet newspaper article by corresponding member of the Academy of Sciences Andrey Yershov. (Yershov heads a department of the computer center at the academy’s Siberian branch

and is in charge of a group of projects on computerization and the introduction of personal computers in secondary schools.) The first level of instruction, which will be introduced this September, consists of a general introduction to the basic principles of computers and computer programming. This will be accomplished in the form of a mandatory course entitled “Fundamentals of Information Science and Computer Technology,” which is to be offered in every Soviet secondary school. Schools which are not equipped with computers (probably the vast majority in the early years of the program) will offer a “computerless” version designed to give the student a chance to master the theoretical and cognitive aspects of the course. The course will begin in the ninth grade and is expected to occupy about 60 hours of teaching time. In addition, about 100 hours will be spent on practical exercises in school computer laboratories (see photo).

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The second level of instruction, which presumably will be implemented during the later phase of the program as more PCs are installed in the classrooms, involves more intensive study of programming and computer use and will occupy 80 teaching hours and 300 hours of practical exercises. Yershov envisages that, by the end of the century, at least 1 million students will be participating in this stage of the program.

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In vocational-technical schools, new specialties are being introduced covering the use, design, and production of computer technology. According to Yershov, these schools should turn out at least 200,000 computer specialists a year. In addition, students who have gone through the second-level program in a secondary school will be eligible to enroll in a technical school, or *tekhnikum*, for advanced training as systems and applications programmers.

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¹ “On Further Improvements in General Secondary Education for Young People and Better Operation of General Education Schools.”

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Students in a secondary school in Moscow learning how to program computers.

Sovfoto ©

Soviet interest in computerization appears to stem from the concern that the USSR is forgoing many of the educational, industrial, and scientific advantages that are apparent in the Western "computer revolution." The literacy program will contribute to the computerization effort by fostering a greater acceptance and general knowledge of computers and their uses. It should also help alleviate the serious shortage of skilled programmers and computer users by creating a pool of people who can more readily benefit from advanced training and by identifying talented students for accelerated teaching programs. USSR Academy of Sciences President Anatoliy Aleksandrov, one of the first to call for a literacy program, has described the achievement of computer literacy as important as the drive to eliminate basic illiteracy

A Soviet View of the PC Revolution

In a public lecture in Leningrad on 20 September 1985, an official provided insights on Soviet perceptions of personal computers.

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Audience Question: *What is a personal computer?*

Answer: It is a computer for work or home use. Some 17 million have been sold in the United States. Many of our colleagues (referring to the speaker's panel) have them. For example, I was at the home of an American, and he called up on his computer a full set of current data on the US economy. They can also be used to play computer games. A rich country like the United States can afford itself computers. They cost perhaps \$800 to \$1,000. A person chooses between buying a car, a television, or a computer. We here are just beginning to approach computers in a serious way.

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after the revolution. Aleksandrov publicly lamented that the Soviet Union fails to make efficient use of even the small number of domestically produced computers because of a shortage of trained personnel and inadequate awareness among middle- and top-level Soviet managers of the potential of computers. Concern over the primitive state of PC awareness in the USSR increasingly has become a subject of public discussion (see inset).

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Not all Soviet scientists are so enthusiastic about the increased use of personal computers. The director of the academy's Institute of Automation and Electrometry, Yuriy Nesterikhin, said in a recent newspaper article that the Soviets must approach the use of PCs carefully because they are a "borrowed idea" and "must be translated to our language and correlated with our conditions." Nesterikhin favors the idea of the collective "departmental" method of using computers, relying on large mainframe computers that are more easily controlled.

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The Soviet Agat Personal Computer

The Agat is the Soviet Union's first and primary general purpose microcomputer or PC. According to a Western expert who has operated the Agat, the disk operating system (DOS), read-only memory (ROM), and interface software are copied directly from the popular Apple II. The system uses a color monitor and has a 64-kilobyte internal memory. Although the system is transportable, it is not truly portable. [redacted]



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[redacted] the Soviets are experiencing some serious problems with the Agat:

- [redacted] the Agat has been unreliable. [redacted] problems with both the hardware and software and that the Soviets lacked the sophisticated technology and industrial base to produce advanced microelectronics.
- [redacted] the Soviet machine ran 15 to 30 percent slower than the Apple II computer on which it is based. [redacted] the disk drive was noisy, and the 64K of internal memory was not expandable. [redacted]

Byte ©

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Although the Agat was produced in limited quantities by late 1983, progress has been slow. We believe only a few thousand are slated for delivery in 1985. By contrast, the Apple IIc was introduced in April 1984 and industry sources estimate that almost 900,000 units will be produced by the end of 1985. Moreover, in the nine years that Apple has been producing its Apple II series of PC, 3.6 million units have been sold. [redacted]

Soviet Industrial Deficiencies

The biggest obstacle to the implementation of the computer literacy program is supplying and maintaining the necessary computer equipment. According to the Academy of Sciences' Yershov, more than 50,000 computer labs equipped with 1 million PCs will be needed just to implement the first, or preparatory, level of the program. To give an indication of the immensity of the task, a recent *Trud* article reported that the Soviet computer industry is scheduled to deliver about 1,300 PCs to schools this year and that 200 classrooms equipped with foreign-made computers for ninth-grade students will open this fall. During PC purchase negotiations with the Japanese and Australians, the Soviet indicated that they plan to equip each school with a single module of 16 to 20

computers. According to this scenario, approximately 265 schools (or less than 1 percent of all secondary schools in the USSR) will have their own computers this year. [redacted]

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[redacted] the USSR is about eight years behind the West in the development of computer technology.² The Soviets have particular difficulty producing personal

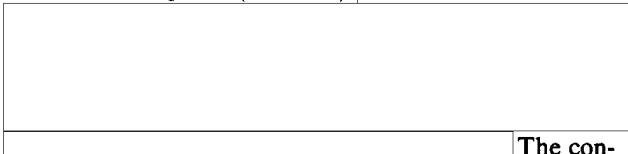
² [redacted] the statement corresponds to Intelligence Community estimates of a lag of four to 10 years in the development of various aspects of computer technology. [redacted]

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computers. The primary Soviet-produced personal computer—a copy of the Apple—has been plagued with performance and production problems and is unlikely to meet the needs of the computer literacy program, either quantitatively or qualitatively, for at least the first phase (see inset).



The construction technique is prohibitively labor intensive and not readily adaptable to mass production. Yevgeniy P. Velikhov, vice president of the USSR Academy of Sciences and head of the Academy's recently formed Department of Information Science, Computer Technology, and Automation, stated in a recent journal article that the Soviet Union produces only "dozens" of PCs per year (see inset). In addition, a recent Soviet newspaper article pointed out that the Soviet computer industry meets only 5 percent of its small-computer needs. Yershov provided some more optimistic figures when he stated in a recent newspaper article that more than 1,300 Agat personal computers will be delivered to Soviet schools during 1985. Even this number is dwarfed in the West by IBM alone, which sold 1.5 million of its PCs and PC Jrs. in 1984.



The Soviet computer industry also has been unable to provide its customers with adequate maintenance support. According to recent articles in the Soviet open press, industrial and economic enterprises are having trouble obtaining reliable technical service for their computers. Problems cited included a lack of spare parts, shortage of trained personnel, and an incentive system that actually encourages shoddy repairs. The head of the Soviet institute responsible for purchasing foreign-made PCs for the literacy program, academician Boris Naumov, admitted that servicing computers is currently beyond the power of most schools. Naumov said that allocation decisions in the early stages of the program will be based on the ability of the schools to provide maintenance for the PCs.



Acquiring Western Computers

The most attractive vehicle for meeting long-term program objectives, while simultaneously improving

Yevgeniy Velikhov



Soviet Life ©

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Yevgeniy Velikhov is an Academy of Sciences' Vice President and Chairman of the academy's Information Science, Computer Technology, and Automation Department. This department was created in March 1983 to oversee the introduction of computer technology and automation into all areas of Soviet society. He also chairs the Automation of Scientific Research Council and the Interdepartmental Scientific and Technical Council that is dually subordinate to the Academy and the State Committee for Science and Technology (GKNT). We believe that Velikhov supervises a number of classified research programs that have weapons applications—particularly the program to develop directed-energy weapons. Many Soviet and Western observers consider Velikhov to be the most likely candidate for the position of Academy president when the present incumbent, Anatoliy Aleksandrov, steps down. Velikhov is also active on the board of the foreign trade association V/O Litsenzintorg, which imports and exports patents and licenses.

[Redacted]

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domestic production capabilities, probably is the purchase of a Western-built turnkey computer plant. Such a plant could be operational within two to three years of a signed agreement and would prove an effective mechanism to transfer Western production

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technology and know-how. The Soviets have already started negotiations with several Western companies to build a PC plant in the USSR. A British journal reported that, during Gorbachev's visit to England last December, Soviet officials met with representatives of a British computer firm to discuss the construction of a turnkey PC plant that could cost up to \$10 million.

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Soviet interest in a Western-built turnkey plant has centered primarily on a facility to manufacture sophisticated 16-bit machines of the IBM-PCXT class. This is the area where the Soviets need the most help, and the acquisition of an entire plant would be an attractive method of quickly obtaining an indigenous capability. The Soviets also recognize the importance of the more powerful PCs for industrial and economic management applications and are eager to make them more widely available as part of the industrial modernization effort. They are probably less interested in a plant to build the smaller eight-bit PCs—although they would probably settle for this if necessary—both because they can buy this type of computer more readily from the West and because their own industry is capable of producing eight-bit PCs in limited numbers and may be capable of mass-producing them in the near future with only limited Western assistance.

To satisfy the immediate requirement for computers, the USSR, spurred by recently relaxed COCOM trade controls on certain PCs,³ negotiated with several

³ Under new rules set by COCOM, Western companies are allowed to sell low-powered, eight-bit microcomputers to the Soviets without a license. These machines process data eight bits at a time, rather than the 16- or 32-bit rates of more powerful business computers. They have fairly small memories and would be sold in the West for \$100 to \$500 each as home computers. Sales of more sophisticated machines remain tightly controlled.

Western and Japanese firms to buy PCs and related equipment. The Soviets appear to be interested in buying modules of PCs linked together in networks of 16 to 20 units, with one teacher station to monitor the students' activities and one printer for each module. At least two potential suppliers of these PC networks have been approached. An Australian newspaper recently reported that a domestic computer manufacturer was close to concluding a deal with the Soviets to provide 5,000 educational microcomputers for a test run in 300 schools (16 computers per school). If the trial run is successful, the Soviets have reportedly promised longer term contracts to equip 80,000 schools with the same system.

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the PCs involved are small, eight-bit machines, which are not under COCOM trade controls.

In March 1985, representatives of a Soviet trade organization initiated discussions on the possibility of buying a large number of Apple IIe and IIC personal computers. Soviet officials have also contacted computer firms in other Western countries, setting off intense competition. Several press reports indicated in July that a Japanese trading company had outbid 26 computer firms from around the world (including the US firm Apple) to win a contract to export 4,000 eight-bit personal computers and an undisclosed number of printers to the USSR. This is the first known contract that the Soviets have signed with a Western or Japanese firm for the purchase of PCs.⁴

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⁴ The Soviets have also been actively seeking more powerful PCs to train advanced programmers in technical schools and universities and to take advantage of their data base and graphics capabilities to increase the productivity of research and design work. In December 1984 the Academy of Sciences placed an initial order for 50 IBM PCXT computers, declaring that it intended to purchase a total of 10,000 during the next year or so.

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We believe the Soviets will focus their PC purchases on a relatively small number of suppliers to ensure that the incoming computers are compatible, both with each other and with Soviet-produced models, and to reduce the complexity of the arrangements for maintenance and replacement. The Soviets will have to work closely with Western suppliers to establish a network for providing spare parts and installing and servicing these machines. The Soviet record in ensuring follow-on support to considerably less ambitious Western-supported projects—such as major industrial complexes—has been spotty at best. These support activities also could drain resources from indigenous Soviet developments and could lead to a dependence on Western equipment.

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Despite the approaches being made to Western computer firms, the USSR probably will limit PC purchases to 4,000 to 5,000 machines for the coming school year. The scale of such imports will be limited by the need to preserve hard currency, the problem of providing service and spare parts for the PCs, and the desire to develop a domestic PC production capability as quickly as possible.

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Domestic Opposition

Importing computers from the West appears to be an option that is strongly opposed by some Soviet scientists and industrialists who fear this would stifle development of indigenous computer production.

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access to duplicating equipment, the prospect of millions of personal computers—each a potential printing press when coupled with a printer and word-processing software—alarms the political leadership. PCs could revolutionize the *samizdat* process. Floppy disks and cassette tapes would expedite the person-to-person transfer of information. Intercomputer electronic communication, while probably subject to state monitoring and control, could threaten the regime's control of information. Aside from the "subversive" threat, use of PCs for transmitting data over computer networks or as a means of remote access to state data bases could increase the prospects of compromising state secrets or leaking embarrassing information, which the state now routinely suppresses.

The Soviet press has also raised concerns about computer crime and the use of computers to generate false information. Central authorities probably fear that, if computerization leads to electronic record-keeping replacing paper documentation, embezzlement or report padding by managers skilled in computer manipulations will become almost impossible to detect. Falsification of data by factory managers is already a serious problem in the Soviet Union, and a major increase would probably further erode the integrity of the statistical data upon which the central authorities base their planning and management decisions.

Increased use of computers also could provide factory managers with the means to evade instructions handed down from central authorities. Managers might use their computer resources to work out alternative production, supply, or marketing variations to demonstrate that the instructions from the State Planning Committee or the ministries are far from optimal for their enterprises. If factory managers acquire computer skills but party officials do not, party officials could find themselves at a disadvantage when economic decisions are being made. Managers might use studies generated by their computer staffs to rebut advice or instructions from the secretaries of the factory's party committee or higher party officials.

Opposition is also likely to come from party and police officials who perceive widespread use of computers as a threat to the traditional state monopoly of information in the USSR. In a society which tightly controls

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Additional opposition comes from officials who fear the social consequences of computerization. These concerns have been raised with increasing frequency as the pros and cons of computerization have become a subject of discussion in Soviet academic journals. A series of articles in the scientific and theoretical journal of the USSR Academy of Sciences reviewed studies of the computerization experience in the West. These and other articles have pointed out that some of the undesirable social effects of computerization might occur in the USSR. The formation of "utilitarian, rational" values, which would undermine the official ideology, and greater social inequality are some of the key concerns raised in these discussions. Some authors remind their readers of computer-created unemployment in the West and warn that computerization may entail significant costs to those segments of society least able to meet the demands of the computer revolution.

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Party ideologists apparently are among those most concerned with the social and political implications of computerization. The party journal *Kommunist* warned against the "computer fetishism" demonstrated by officials who advocate computerization "at any price" and who see universal introduction of computers as a cure-all for economic and organizational problems. A candidate of philosophy, whose articles have appeared in both the party journal and the journal of the Academy of Sciences, has pointed out the need to understand clearly the dangers inherent in uncontrolled and unlimited computer application. He criticized the work of the Academy of Sciences and the State Committee for Science and Technology for focusing on the scientific and technical problems of computerization while ignoring or neglecting social and political problems.

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seriousness of the obstacles and the backwardness of the Soviet PC industry, however, have led the Soviet leadership to take an extremely cautious course that will effectively delay widespread realization of these benefits until at least the early 1990s.

The ultimate success, both of the literacy program and of the computerization effort in general, will depend on the Soviets' ability to manufacture and service at least hundreds of thousands of reliable PCs and to overcome user resistance at the enterprise level. Upgrading the performance of the computer industry will require significant Western assistance, at least in the short term, in the form of a turnkey plant or the direct sale of computers and related equipment. We believe the Soviets will be able to mass-produce the less powerful eight-bit PCs needed for the school program in the near term, but the production of the more sophisticated 16-bit business computers, which will be needed for industrial applications, will continue to be a problem for the near future. Production difficulties in this area, unless the Soviets can obtain a turnkey plant, will hinder efforts to automate industrial facilities.

The pace and success of the program also will depend on the willingness of the leadership to take the political risks entailed. A cautious approach, with tight controls on the provision and use of PCs, will impede familiarization with computer technology and stifle innovative applications. On the other hand, loose controls could lead to unauthorized use and possibly precipitate a backlash.

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Extension of the literacy program to include the teaching of other subjects by computer will be delayed by the need to develop Russian-language educational software. The software will have to be internally developed because of the general shortage of quality software of this type, even in the West, and because of Russian-language requirements. In view of the limited capabilities of the Soviet software industry, the development of course software, needed in the second phase of the literacy program, will be a problem area for some time.

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Outlook

Although the payoffs are not likely to be realized until the 1990s, the computer literacy program is regarded by the leadership as an important component of Gorbachev's plan to revive the economy through "intensive" growth in productivity. The program will augment industrial modernization efforts by spurring demand for domestic PCs, increasing the supply of computer programmers, and eroding some of the resistance to computer use, mainly at the plant level. The

The most serious threat to US interests posed by the literacy program is the potential transfer of a turnkey plant that would provide the Soviet computer industry with much needed Western production know-how and equipment. A turnkey facility for even eight-bit PCs could significantly enhance Soviet production capabilities. Since COCOM restrictions on eight-bit computers were relaxed in January 1985, the Soviets have intensified their efforts to acquire a vertically integrated plant capable of producing the entire range of microelectronic devices and peripheral units—such as microprocessors, disk drives, and printers—that make up a personal computer. Experience in producing these subsystems would benefit the computer industry generally. [redacted]

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The transfer of an eight-bit PC plant could also provide an opening wedge for later acquisition of technology to produce the more sophisticated 16-bit PCs required for many military and industrial applications. The higher speed microprocessors used in these PCs have a range of weapons signal processing and guidance applications. In manufacturing, 16-bit microcomputers are suitable for wide application in process, inventory, and machine control as well as information management systems. They are particularly useful for highly efficient computer-aided design tasks routinely applied in the West in the development of complex products such as custom integrated circuits. Component improvements, in turn, fuel further advances in computer and other advanced manufacturing technologies vital to Soviet efforts to improve industrial efficiency and productivity. Although PC turnkey plant sales are currently prohibited by US and COCOM regulations, West European vendors in particular are interested in such sales. [redacted]

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